

the introduction of light energy follows the same law in the light as in the dark. In the latter circumstances, the only active forces are those of chemical affinity. The influence of the light energy is therefore quite different in its effect upon the reacting substances from that of electrical energy, the effect of the latter being regulated, of course, by Faraday's law.

THE additions to the Zoological Society's Gardens during the past week include a Bennett's Wallaby (*Macropus bennetti*) from Tasmania, presented by Lady Boord; a Spotted Salamander (*Salamandra maculosa*) from Italy, presented by Mr. G. Bottini; two Bennett's Wallabys (*Macropus bennetti*) from Tasmania, a White-fronted Amazon (*Chrysotis albifrons*) from Cuba, three Ring-necked Parrakeets (*Palaeornis torquatus*, var.), a Gangetic Trionyx (*Trionyx gangeticus*) from India, a Ruff (*Muchetes pugnax*), a Skylark (*Alda arvensis albino*) British, a Himalayan Monaul (*Lophophorus impeyanus*) from the Himalayas, deposited.

OUR ASTRONOMICAL COLUMN.

NEW VARIABLE STAR 21, 1902, SAGITTÆ.—From photographs taken by M. S. Blakjo at Moscow, Madame Ceraski has found that the star having the position

$$\begin{aligned} 1855 \alpha &= 20^{\text{h}}. 13^{\text{m}}. 47^{\text{s}}., \delta = +20^{\circ} 39' 0. \\ 1900 \alpha &= 20^{\text{h}}. 15^{\text{m}}. 46^{\text{s}}., \delta = +20^{\circ} 47' 3. \end{aligned}$$

is a variable.

The magnitude varies from 9.5 to 11.5 or a little more, and M. Blakjo believes the period to be a long one, perhaps several weeks or months. In September, the actual visual magnitude was 11.5 (*Astronomische Nachrichten*, No. 3836.)

"THE HEAVENS AT A GLANCE," 1903.—The seventh yearly publication of this handy card is full of useful astronomical information for amateur observers. In addition to the usual monthly "Celestial Diary," tables of "Sidereal Objects" and "Descriptive Notes," it contains two small star charts which will be found very useful. The card may be obtained from its compiler, Mr. Arthur Mee, Larishen, Cardiff, price sevenpence, post free.

OBSERVATIONS OF LONG-PERIOD VARIABLE STARS.—In Nos. 3835-6 of the *Astronomische Nachrichten*, Father Esch, S.J., of Valkenberg, gives the detailed results of his observations of seventy-eight long-period variables. The objects are denoted by their names and numbers in Hagen's "Atlas Stellarum Variabilium," and the dates of their maxima, with the amount of variation from the elements given in the Atlas, are given, together with their range of variability and remarks by the observer.

OBSERVATIONS OF OCCULTATIONS.—Mr. G. W. Hough, director of the Dearborn Observatory, gives the details of his observations of ninety-one occultations of stars by the moon, during the years 1900 and 1901, in No. 528 of the *Astronomical Journal*.

He divides the phenomena into four classes, and in the fourth class he places those in which the star appears to be projected on the earth-like disc of the moon for some seconds before the final disappearance; he explains this phenomenon by suggesting that, as the edge of the moon is not a smooth outline, the star may pass behind the moon at a point where there is a depression in the limb and so appear to be projected beyond the geometrical outline of that limb.

In the case of the occultation of the star D.M. + 20° 807 on February 25, 1901, the star apparently disappeared and the time was recorded, but it was seen again and a second record made 3.8 seconds after the first. This phenomenon was undoubtedly due to the reduction in light of a close double when the one component had passed behind the limb, for the object was afterwards identified as Ho 332, $p = 125.9$, $s = 1''.03$, 9m.-9m.

The phenomenon observed on the occultation of the star S.D.M. - 20° 4810, on October 17, 1901 ($p = 106''$), belonged to the fourth class mentioned above, for the star appeared to be projected on the limb of the moon two or three seconds before its disappearance.

THE VACCINATION ACTS.

THE present position of the law relating to vaccination in England is indefensible. There is probably no great question in the domain of medicine on which the medical profession are nearer to absolute unanimity than that of the value and necessity of vaccination as a protection against small-pox. Independently of professional authority, perhaps no medical doctrine has for its basis so great an amount of statistical evidence gathered over so wide an area for so long a time. This unanimity of belief and this statistical evidence are equally strong and of equal value as regards the primary vaccination of infants and the revaccination of adolescents.

It is not the purpose of this paper to cite any of the evidence in question. What the writer desires to point out here is that the existence in this country of Acts of Parliament making vaccination of children obligatory, or even providing expensive administrative machinery for the vaccination of persons voluntarily asking for it, must be taken as proof that Parliament accepts the conclusion that vaccination prevents small-pox. But the legislature is in the strange position of insisting on infantile primary vaccination and of making no requirement whatever regarding revaccination. At one time, and indeed up to a comparatively recent date, this attitude was defensible, for the great mistake of Jenner's life was that he believed a single vaccination to be sufficient for permanent protection, and the veneration naturally entertained for his name and work probably delayed general recognition of the need for repetition of the operation. That need, however, has now long been recognised, and the experience of Germany shows that vaccination in infancy and a single revaccination at a proper interval afterwards are sufficient to confer national protection against small-pox, though no doubt in any such protected nation or empire there will be individuals who owe their freedom from small-pox more to their being surrounded by a vaccinated and revaccinated population not liable to epidemics than to the permanence of their own personal immunity. No argument can be used in favour of a law of primary vaccination which is not also valid for a law of revaccination. If there is any reason for having no Revaccination Act, the same reason exists for having no Vaccination Act at all. Both should stand or fall together.

The importance of a Revaccination Act for England was prominently but unsuccessfully brought before Parliament when the law was being altered in 1898 by the passing of the temporary Act which came into force at the end of that year. The main features of that measure were the provision of domiciliary vaccination and the much-debated Conscience Clause. The Act was passed experimentally only for a period of five years, and comes to an end on December 31, 1903. Next session is practically certain to see one of two alternatives adopted by Government. Either new legislation will be introduced or the Act of 1898 will find a place in the Expiring Laws Continuance Bill. This latter course would shelve several questions which cry out for solution and ought not to be shelved. To prevent its adoption and to help Government to frame any new measure on the best lines are among the principal reasons for the formation of the Imperial Vaccination League, the first meeting of which was held in London lately under the chairmanship of the Duke of Northumberland. The League has other important objects before it. It desires to educate and interest the public generally in the subject of vaccination and revaccination. As concerns legislation, it has under consideration by separate sub-committees the questions of a Revaccination Bill, the supply of lymph prepared by Government or under Government supervision for the needs of the whole country, and the question of the proper local authority for the administration of the Vaccination Acts. The last of these, though an important administrative subject, is after all of much less public moment than the two others—the protection of the lymph supply and obligatory revaccination.

The risks attached to arm-to-arm vaccination in this country were greatly overstated by anti-vaccinationists. In no class of the population was arm-to-arm vaccination more uniformly resorted to than in the families of medical men, and the Royal Commission, which sat for the long period of seven years, concluded, after elaborate inquiry, that the risks were insignificant and were diminishing. Nevertheless, they recognised that the fear of injury from vaccination and especially the fear of syphilitic inoculation was a potent factor in hindering people from securing the protection of their children against small-pox.

Quite independently of such fears—and this also, of course, the Commission pointed out—it is the obvious duty of the State to take every practicable precaution to prevent harm to the individual through the operation of any Act of Parliament. This applies alike to vaccination and to hospital isolation. If, for the public good, a child is removed from the parental roof to a public hospital, the authority so removing it, and coming temporarily *in loco parentis*, is bound to exercise the utmost care in the protection of the child. Though vaccination differs from hospital isolation in respect that it is done directly for the benefit of the child and only indirectly for the good of the public, yet the obligation remains. Every risk, no matter how slight, should be minimised by every practicable and reasonably available means before the State compels the parent to procure the vaccination of his child. The demand, therefore, that Government shall itself supply for every required vaccination calf lymph treated according to the best known methods—methods which have been much improved since the Commission issued its Report—or shall efficiently supervise the manufacture of lymph by private makers, is a most reasonable one, and has the support alike of lay and medical opinion.

It is necessary to consider how this can be done. Here, as in every other mundane affair, questions of finance and economy arise. Before the Act of 1898 came into force, public vaccinators appointed by boards of guardians performed about half of the primary vaccinations done in London and about two-thirds of those done in the provinces. How the figures now stand I do not know, but at present all that Government undertakes with regard to lymph supply is to meet the requirements of public vaccinators. Private practitioners must find their own lymph. This, at first sight, seems a harsh and arbitrary rule, but it may be assumed that the Local Government Board has some ground for its attitude. The facts of the case furnish the explanation. For due removal of extraneous organisms, calf lymph has to be stored for one month in the glycerine with which it is mixed. If lymph be used too soon, insufficient removal of such organisms may result occasionally in an unnecessary degree of inflammation accompanying the formation of the vaccine vesicles. If stored too long, on the other hand, the lymph may become inert for purposes of vaccination. At present there is great irregularity of demand for vaccine lymph in England, depending on the absence of systematic revaccination and the occurrence of epidemics of small-pox. If under present conditions the Local Government Board must always be ready to provide sufficient lymph to every medical man who asks for it for vaccination and revaccination during small-pox epidemics, a great establishment will have to be set up, producing month by month such amounts of lymph as may not be wanted at any time for ten or twenty years on end, and month by month this huge excess of valuable material will have to be thrown away. Merely to set forth such a scheme is to condemn it. How, then, is the object to be accomplished? The answer is, only in one way, and that way a Revaccination Act. Under such an Act, revaccination would be obligatory at about the age of twelve years. The information necessary for working the Act would be most readily obtained from the registers of the elementary schools. The vaccination officials would be furnished at frequent intervals, say every three months, with lists of children about to attain the specified age. Primary vaccination would, of course, remain obligatory as at present. Both revaccination and primary vaccination, it may be assumed, would be subject to a Conscience Clause, though the present Clause is open to considerable amendment. The work of vaccination would go steadily on. The Government laboratories would be on a scale suited to meet the requirements of the nation, and the public funds would not be squandered in maintaining an institution the full work of which would be utilised only at rare intervals. Outbreaks of small-pox would be few and local and limited in degree, and the laboratories would easily meet demands for lymph for revaccination of "contacts" and others on such occasions.

Another great advantage from systematic revaccination would be an enormous saving in the provision and maintenance of small-pox hospitals. At present, local authorities are, with regard to this matter, in a most exasperating position, and that through no fault of their own. The Local Government Board insists that, owing to an evil which has often resulted from such hospitals—the spreading of small-pox throughout the surrounding community—these institutions for the isolation of patients shall themselves be isolated. Small-pox is a disease for which hospitals are almost entirely unnecessary in

a duly vaccinated and revaccinated community, yet local authorities have no power to enforce such protection of their community, and when they set about trying to provide hospitals, they experience the utmost difficulty in obtaining safe sites. Other economies would result from the scheme here briefly sketched, but the above are the main reasons for asking Government to introduce a Revaccination Bill, and are also among the main reasons for the formation of the Imperial Vaccination League. Already the Jenner Society has done most admirable work in the same field, and both are well worthy of public support, especially at so critical a time in the history of legislation for the prevention of small-pox.

In criticism of the plea for a Revaccination Act as here put forward, it may perhaps be urged that the acceptance without demur of a Conscience Clause with regard even to primary vaccination is hardly consistent with a demand for a law of revaccination. What would be the sense, it may be asked, of establishing all the additional machinery which a Revaccination Act would involve for the protection of the public against small-pox and at the same time telling the public that if they please they can evade both primary vaccination and revaccination by satisfying a bench of magistrates that they have a "conscientious" objection on the subject? The force of such a contention is not to be denied. Admittedly, the Conscience Clause is a concession to expediency. For justification of such a concession, we must go to the facts of the position. In the first place, it is important to note that the Royal Commission on Vaccination suggested a Conscience Clause with the object, not of lessening the practice of vaccination, but of increasing it. In the second place, even before the Conscience Clause was passed, vaccination was not in any real sense of the word compulsory. In order to evade the operation, it was only necessary to pay a fine, either once or repeatedly, according to the activity or otherwise of the local guardians. The law never allowed a local authority to take a child by force out of a parent's arms and vaccinate it. Exemption, therefore, though not by way of certificate, was always possible. Laws must be framed and administered with due regard to the spirit of legislation which prevails in the country. If it so pleases, Parliament has a right to adopt the attitude that, bad as are small-pox epidemics, they are a lesser evil than would be the exercise of absolute force in such a matter as the insertion of vaccine lymph into the arm of a child notwithstanding the determined opposition of the father. The fining of persistent and active anti-vaccinationists, the public sale of their goods in default of payment of such fines, or the imprisonment of objectors where payment of fines could not in this way be obtained, have been in the past measures most favourable to agitation against vaccination. The purpose of the Conscience Clause in the Act of 1898 was to sift the genuine and confirmed opponent of vaccination from the merely careless and indifferent parent who had no opinion on the subject, but would leave the matter alone so long as he himself were left alone, and would, on the other hand, have his child vaccinated if he found that that would cause him less trouble than to take the steps required to obtain exemption from the law. On the whole, the Conscience Clause of 1898 has probably promoted vaccination rather than hindered it. Yet in practice the clause has proved itself defective in two directions. Its administration has been left to benches of local magistrates, and their views vary much as to the proceedings which should be taken. In one place, an anti-vaccination bench may hold evening sittings where long strings of alleged "conscientious objectors" pass rapidly in front of the bench and are detained only so long as is needed for adhibiting magisterial signatures to exemption certificates. At such gatherings, either fathers or mothers may attend. On the other hand, other benches of magistrates may refuse almost any evidence submitted to them on the ground that it does not "satisfy" them that conscientious objection exists, and in Parliament it has been stated, in answer to questions on the subject, that there is no power under the Clause to compel a magistrate to be "satisfied" with any amount of proof. A parent whose certificate is refused in such a court may afterwards be brought before it for having failed both to have his child vaccinated and to produce an exemption certificate. Obviously, the present Conscience Clause allows too much variety of practice and requires a substitute less open to these objections, a substitute which, if possible, should so detail the proceedings to be taken that, on the one hand, they would involve at least as much parental trouble as the procuring of vaccination would cause, and, on the other hand, would not

needlessly pester nor afford the notoriety of cheap martyrdom to any man sufficiently wrong-headed to be quite determined to resist the vaccinal protection of his child.

As regards the example of Germany, however, and the prospect of similar immunity, which I have ventured to hold forth as an inducement for the passing of a Revaccination Act in this country, it may well be asked, May not the operation of a Conscience Clause result in a condition of national protection far short of that of Germany? It is unsafe to prophesy here, but personally I am not very much afraid of that contingency. With such a well-organised system of vaccination and revaccination as could be easily and, I believe, very economically established, there would, I think, be comparatively little default throughout the country as a whole. The latest returns show that in London conscientious objection is registered with regard to about 1 per cent. of the children, and in the rest of England about 5 per cent. These figures might in the future alter either upwards or downwards, but with a well-thought-out Conscience Clause the change might be downwards rather than upwards. In some special localities, however, the amount of default might, at least for a time, be very considerable, and such places would be a danger both to themselves and to their neighbours. In Germany, a large part of the trifling amount of small-pox that still remains occurs near the frontiers where there is opportunity for importation of the infection from other less protected countries. We, however, have a sea boundary and are less exposed to such risks, so that the existence in our midst of imperfectly protected places might not be more than equivalent to the risk which Germany runs from its imperfectly vaccinated neighbours. Such places in England would have the benefit of being surrounded by a vaccinated and revaccinated nation. Small-pox would not readily reach them, and when it did the surrounding communities would, through their systematic revaccination, be in a much better position than at present to resist the virulose invasion. Moreover, when once small-pox gets a good footing (though, unfortunately, not until it really has a good footing) in an imperfectly protected community, it has a wonderful effect in temporarily promoting vaccination. When Gloucester had attained a higher percentage neglect of vaccination than any large town in England, the result of a great small-pox epidemic was to leave it the best revaccinated town in the realm. In presence of an outbreak in future, it would not be in the least surprising to find the names of some children appearing on two lists in the course of the same year, first as subjects of conscientious objection and later as subjects of successful vaccination. Looking to all the facts of the case, I think this country may be able to afford a Conscience Clause, and it would certainly be infinitely better off under a Revaccination Act with a Conscience Clause than without any Revaccination Act at all.

As reference has repeatedly been made here to the example of Germany, it may be proper just to indicate, in a sentence or two, its position with regard to vaccination and small-pox. The facts are taken from a very useful tract published by the council of the British Medical Association.¹ In Germany, vaccination of children in the course of their second year is compulsory, and also revaccination of all school children in their twelfth year. That has been the law since 1874. In the nine years 1866-74, the small-pox deaths per million in Prussia were, respectively, 620, 432, 188, 194, 175, 2432, 2624, 357, 95. In the years 1875-1898, the corresponding figures have been 36, 31, 3, 7, 13, 26, 36, 36, 20, 14, 14, 5, 5, 3, 5, 1, 1, 3, 4, 3, 0.8, 0.2, 0.2, 0.4. In Austria, without compulsory vaccination, the annual rates 1887-1896 have been 440, 640, 520, 250, 290, 260, 250, 110, 47, 35. The figures for all Germany do not begin until 1886, and are as follows in the years 1886-99:—4, 3.5, 2.3, 4.1, 1.2, 1.0, 2.1, 3.1, 1.7, 0.5, 0.2, 0.1, 0.3, 0.5. In short, "small-pox epidemics are utterly abolished from Germany, and only a few scattered deaths occur each year, mostly on the frontiers (Russia and Austria)."

As illustrating what has been said already about the protection derived from living in a vaccinated and revaccinated community, I quote in conclusion the following passage regarding the Prussian army:—

"The law of 1874 made no difference in the vaccination of the Prussian army, which enjoyed good vaccination ever since 1834: every recruit being vaccinated on joining—twice if necessary. But the law of 1874, which only directly affected

infants and school children, made a great and striking difference in the small-pox mortality of the army. Previously there were a few deaths, one or two, almost every year, but after 1874 there was not a single death for ten years, and only two deaths (1884 and 1898) in the whole period 1875-98. The first death is that of a reservist twice unsuccessfully vaccinated in the army. This shows that the protection which an individual acquires by vaccination is increased by his being surrounded by a well-vaccinated community."

JOHN C. M'VAIL.

AN AMERICAN REPORT UPON THE WEST INDIAN ERUPTIONS.¹

DR. E. O. HOVEY, associate curator of the geological department of the American Museum of Natural History, New York, was sent by that institution to Martinique and St. Vincent to study the phenomena accompanying the great eruptions of Mont Pelée and La Soufrière of last year, and the report referred to below deals almost entirely with his personal observations. The report first discusses the May eruptions of La Soufrière, the author being a member of the first party, on May 31, to ascend that mountain after the eruptions of May 7 and 18. The party found that the old crater lake for which the volcano had been famous had disappeared, but that there was a small lake of (apparently) boiling water in the bottom of a precipitous pit nearly a mile in diameter at the top. The author and Dr. T. A. Jaggar, jun., who also was in the party making the ascent, estimated that the bottom of the pit was about 1600 feet below the part of the rim on which they were standing, or about 2400 feet below the highest part of the rim. A strong column of steam was rising, occasionally including clouds of dust, from the south-east quarter of the lake.

The wall between the great crater and the "New" or 1812 crater seemed intact, and from its lower third there issued a strong stream of water, apparently from waters then collecting in the 1812 crater. The rim of the crater and the upper part of the cone was covered with a thick mantle of mud, which rendered it unwise to attempt to reach the windward side of the volcano along the rim. Ten days later the author, accompanied by Mr. George C. Curtis, of Boston, who was his companion on the first and second ascent and during most of his stay on the islands, made a third and successful ascent from the windward side of the island and stood upon the peak between the two craters. It seemed evident that the small (1812) crater had not taken part in the May eruption, though the summit of the mountain was covered with clouds at the time of the visit.

The explosions attending the May eruptions of La Soufrière expended their strength radially in all directions from the crater. The principal evidence of this is the trees, which lie prone in directions pointing away from the crater, except for modifications due to local circumstances of topography. The roots of the upturned trees showed the effects of the sandblast action of the volcanic tornado, being worn and charred upon the portions toward the crater and preserving the fresh, unburned bark upon the protected parts. The explanation for the explosions suggested is that unusually great masses of superheated steam arriving at the lip of the crater could not find room for expansion upwards on account of the cushion-effect of the column of steam and lapilli preceding them, and the lapilli falling therefrom, and that they expanded with violence horizontally and downward, following the configuration of the mountain. Extensive landslides occurred for two or three miles along the leeward coast.

The particular feature of the May eruptions of La Soufrière was the enormous amount of dust which was thrown high into the air and distributed over a vast, elliptical area, the extent of which cannot yet be calculated for lack of data. The dust appears to have been carried much farther to the east and south-east by the upper currents of air blowing counter to the trade winds, than to the west by the trades. Reports from Barbados and from ships encountering the dust at sea indicate transport by the upper air currents at a rate of about thirty-two knots contrary to the direction of the prevailing surface wind. The other ejecta of the eruptions were fine and coarse lapilli, blocks and bombs. No stream of melted lava accompanied either of the outbursts in May. The lapilli first thrown out

¹ "Facts about Small-pox and Vaccination," &c. (British Medical Association, 429 Strand, W.C.) Price 1½d.

¹ Martinique and St. Vincent: a Preliminary Report upon the Eruptions of 1902, by Edmund Otis Hovey. *Bulletin American Museum Natural History*, vol. xvi. pp. 333-372, pl. xxxiii.-li. New York, October 11, 1902.